SPACE SURVEILLANCE, ASTEROIDS & COMETS, and SPACE DEBRIS

Recommendations from the 1997 Space Surveillance, Asteroids & Comets, and Space Debris Study are divided into the following major topics:

SPACE SURVEILLANCE

For surveillance of objects in low earth orbit, the Air Force should:

- Introduce on-line sensor calibration capabilities using earth satellites with known, high-precision ephemeris products to exploit fully the capabilities of a shrinking sensor base
- Implement an experimental test site in partnership with a Center of Excellence at Schriever AFB, CO for space surveillance technology to evaluate emerging hardware and software technologies in the military and commercial worlds, in order to:
  1. Demonstrate state-of-the-art techniques for data and ephemeris management, in anticipation of needs imposed by emerging Space Control requirements
  2. Demonstrate improved methods for atmospheric density representation
  3. Demonstrate methods of achieving greater autonomy in operations
  4. Provide support capabilities for manned and high-value payloads not routinely programmed in the Space Defense Operations Center (SPADOC) system, and
  5. Demonstrate utility of spaceborne sensors by processing Space Based Visible (SBV) data.

Expand nucleus of Schriever AFB, CO expertise (50 percent scientists, 50 percent operations personnel) to include filter technologies, space debris surveillance and processing technology, and mission assessment & planning

Consider employing the FPS-85 radar connected by data lines to Schriever AFB, CO as the primary radar sensor, using others as necessary

Support dual use of the Ballistic Missile Defense Organization (BMDO) X-band radar for Space Control and debris monitoring

For surveillance of objects in geosynchronous orbit, the Air Force should:

- Complete its upgrade of the Ground-Based Electro-Optical Deep Space Surveillance (GEODSS) network while ensuring that the gaps in eastern Atlantic and western Pacific longitudes are filled.
- An improved GEODSS, with an improved charge-coupled device (CCD) focal plane array and improved software, should be more fully deployed.

In the area of data processing, for the Space Surveillance catalog to be more useful and militarily significant in the near term, Air Force should:

- Employ low-cost commercial technology currently available in the marketplace, such as "special perturbations" algorithms and workstations.
- Establish routine use of the “trusted covariance matrix” technique to ensure interoperability.

For spaceborne sensor systems to replace ground-based systems, the Air Force should pursue surveillance of space from space with search capability. Specifically, the Air Force should:

- Integrate the Space Based Visible camera on Midcourse Sensor Experiment into the satellite surveillance network.
- Establish search and track requirements for the Space and Missile Tracking System of Space Based Infrared Systems (SBIRS) and pursue appropriate redesign.

ASTEROIDS AND COMETS

NOTE: This part of the Study assumes that an improved GEODSS system has been completed. See recommendation for surveillance of objects in geosynchronous orbit above.

The present deployment plan is inadequate. For large NEOs, (near Earth objects) ground-based search with large CCD focal planes on existing telescopes is appropriate. It would be preferable to perform the searches on telescopes mage operational from storage, using CCD arrays that already exist.

Long-period comet threats are more stressing. For them it would be appropriate to begin work on space-based telescopes, including infrared focal planes, for rapid search.

Means of deflection should be studied, particularly kinetic pulverization, in order to define better the requirements for negation.

Experiments are needed that cannot be performed on Earth. Experiments should be performed on asteroids that pass the Earth on suitable trajectories. Soft and hard landings, seismic tests, pulverization, and deflection tests should be performed to obtain the data needed for deflection concepts.

A planning cycle should be executed to see how mission planning, detection, homing, deflection concepts, and control would work under simulated scenarios. While a number of workshops and studies have addressed these issues at top level, it is necessary to integrate their outputs into an overall assessment.

The Air Force is ideally suited for the establishment of a Center of Excellence with a small group to maintain activity and continuity in core areas between meetings—with its goal being the creation of a strawman configuration for detection of large NEOs (near-Earth objects) and LPCs (long period comets) and the kinetic interception of intermediate-size objects.

SUMMARY

The Study Committee recommends that the Air Force:

- Take the lead in detection of NEOs and LPCs
- Mount a gorund-based search program for large NEOs with upgraded GEODSS telescopes.
- Create a small group of knowledgeable scientists and AFSPC military operators
- Integrate the output of past workshops into the overall assessment
- Remain cognizant of activities within the astronomy community relating to studies and experiments of kinetic pulverization and deflection
- Plan a spaceborne sensors program to detect small and intermediate objects and LPCs.

SPACE DEBRIS

The Study results show that the cascading of space debris (see note below) will not be an issue in the coming century.

NOTE: NASA personnel predicted in 1978 that collisional cascading would be an important source of new orbital debris, possibly before the year 2000, and as a result would make low Earth orbits at Space Shuttle altitudes unusable. Out of concern that the United Nations might take actions to further regulate the existing Air Force launch debris mitigation procedures, the SAB was asked to recalculate the debris phenomenon.

It would be appropriate for the Air Force to:

1. Continue to monitor the rates of launch, explosion, collision, and decay; as well as the amount and composition of catalog debris, with its current sensors as part of its responsibility as the DoD agent for space;
2. Establish a nucleus of expertise in space measurements, data analysis, laboratory experiments, and modeling;
3. Increase its expertise and involvement in interagency and international debris efforts, publish scientific papers on expected space environments, and broaden inputs to its models and empirical parameters for debris protection.

SUMMARY

The Air Force should:

1. Assume a more active national and international role in space debris:
   (a) Provide substantive representation at interagency and international meetings;
   (b) Establish systematic monitoring of the debris environment;
   (c) Provide the primary leadership and point of contact for the DoD.

2. Develop a better capability to characterize the space environment:
   (a) Establish a debris model independent of the NASA model;
   (b) Task MIT Lincoln Laboratory to analyze Haystack radar data to determine whether further measurements are required.

3. Provide independent assessment of the debris problem. Establish a nucleus of expertise in space measurements and data analysis.

4. Continue monitoring space launches, explosions, and catalogs:
   (a) Calibrate Air Force sensors to track space debris; and
   (b) Complete modification and deployment of charge-coupled device-improved (CCD) Ground-Based Electro-Optical Deep Space Surveillance (GEODSS)

Since this Study provides new analyses and results that could affect national space policy, a new review by the National Academies should be convened to address any unresolved issues.